NASA ATAC
Revolutionizing Aviation Subcommittee
Airspace Systems Program Task Force

December 12-13
NASA Ames

Revised Advisory Committee Structure

ATAC
Dave Swain (Boeing)

Revolutionizing Aviation Subcommittee
Ed Crow (UT Ret)

Airspace Systems Task Force

J Hansman (MIT)

Safety Task Force

J O'Brian (ALPA)

Vehicle Systems Task Force

M Anderson (Boeing)

SATS Advisory Committee
R Swanda (GAMA)

Airspace Systems Task Force Membership

- **Joe Burns (UAL)**§
- **Steve Bussolari (MIT Lincoln Lab)**
- **Jim Cistone (Lockheed)***
- **John Hansman (MIT)**
- **John Kern (FAA) §**
- **William Leber (NWA-Dispatch)**
- **John O'Brian (ALPA)**
- **Amedeo Odoni (MIT)**
- **Leo Prusak (FAA-LGA Tower)**
- **Ruth Marlin (NATCA)***
- **Robert Schwab (Boeing)***
- **Phil Smith (OSU)**

§ Unable to attend

TF Process

- **Accelerated schedule to meet ATAC reporting deadline**
  - **"Quick Look"**
- **Focused on tasked questions (see next slide)**
  - **Did not focus on accomplishments**
- **2 Day meeting at NASA Ames**
  - **Some read ahead material provided by AS Program**
  - **First day high level reviews of 4 major projects**
  - **Second day TF discussion and outbriefing to project leads**
- **E-mail review**
- **Caveats**
  - **Time did not permit in-depth review**
  - **Limited time to resolve issues or misinterpretations**

Questions Task Force Asked to Address

- Are the goals of the program relevant?
- Is the technology right to achieve the goal?
- Is there a coordination / integration plan with appropriate organizations (OGAs, Industry)?
- Are resources adequate?
- Is there an implementation plan including:
  - NASA activities
  - Transition plan
  - Customer/user implementation issues

Airspace System Program Goals

- Goal: "Enable major increases in the capacity and mobility of the air transportation system through development of revolutionary concepts for operations & vehicle systems"

- Objectives:
    1. *Improve throughput, predictability, flexibility collaboration, efficiency and access of the NAS*
    2. *Enable General Aviation and runway-independent aircraft operations*
    3. *Maintain system safety, security and environmental protection*
    4. *Enable modeling and simulation of air transportation operations*

Airspace System Program Goals

- **Assessment**
  - **High level goal relevant and will increase in importance as economy recovers and delays due to airspace constraints reemerge**
  - **Balance between "revolutionary" and "evolutionary" development**
    - **Goal statement "revolutionary"**
    - **Transition drives "evolutionary"**
  - **Goal should include understanding of the current NAS and the nature and extent of future demands**
  - **Objectives 1,3,4 also highly relevant**
  - **Objective 2 unclear**

- **Goal structure could be more tightly linked**
  - **Theme Objectives>Goals>Program Objectives>Project goals>Sub-Project Objectives**
  - **Goal statements vary by source and time**
    - **Briefing**
    - **Web**
    - **Documents**

Introductory/Overarching Comments

- **The Task Force strongly supports the AS Program**
- **NASA Airspace Program is a vital part of the National Capability in Air Transportation**
  - **NASA has a major research responsibility for NAS modernization**
  - **"NASA is the only modernization research game in town"**
- **NASA has made some significant contributions particularly in the more mature projects (eg AATT, AOS)**
- **NASA has had significant impact on the development and use of trajectory modeling and planning tools to support ATC.**
- **NASA has worked quite sucessfully at developing a good working relationship with the research and operational community**
- **Need for balanced portfolio**
  - **Near and long term investments**
  - **Specific technology/systems versus foundational research**

Introductory/Overarching Comments

- **Need to maintain systems perspective**
- **Episodic (5 year) programs make it difficult to have impact on ATM systems which have 20 year transition time constants**
  - *"As program is getting mature, gaining credibility, interactions set up and starting to have impact it is ending"*

Airspace Systems Program - Projects

- AATT - Advanced Air Transportation Technologies Project
- SATS - Small Aircraft Transportation System Project
- VAMS - Virtual Airspace Modeling and Simulation Project
- AOS - Airspace Operations Systems

AATT Project Goals

- **Goal:** "In alliance with the FAA, enable next generation of increases in capacity, flexibility and efficiency while maintaining safety, of aircraft operations within the US and global airspace system"

- **Focus**
  - Human-centered automation to assist air traffic management decision making among pilots, controllers and dispatchers

- **Objectives:**
  1. Human Error-Tolerant Design
  2. Operational Flexibility
  3. User Preferences
  4. Integrated ATM Concepts
  5. Safety
  6. All Vehicle Classes

AATT - Findings

- **Goals**
  - **The goals of the AATT project are highly relevant.**

AATT - Findings

- **Technology/Approach**
  - **The focus on human-centered automation and decision aiding is a valid approach and builds on NASA capabilities. Other approaches and technologies (eg procedures, airspace redesign, surveillance) should not be neglected.**
  - **The TF would like to have seen more effort devoted to fundamental issues such as understanding the NAS to help identify where the key constraints and opportunities for improvement are.**
  - **The TF noted that the early focus on Terminal Area operations (imposed by early national coordination strategy) limited the ability of NASA to approach the problem at a systems level.**
    - **Resulting focus on ATC-Cockpit Tools**
      - **Limitations due to broader system context constraints which impact the effectiveness and implementability of the tools**
    - **Limited focus at TFM-AOC level**
      - **Including Strategic and Tactical planning and execution**

AATT - Findings

- **Coordination, Integration**
  - **NASA-FAA (key customer) relationship has evolved over the program**
    - **Need to maintain and build on this relationship**
  - **Developed collaborations with other key organizations**
    - **MITRE, Lincoln Lab, Volpe, Airlines, NATCA**
  - **Relationship with Labor groups influenced by Automation Centric approach**
  - **Concern regarding future access to operational resources, controllers, facilities and Traffic managers**
  - **Need to capture lessons learned for downstream programs**

AATT - Findings

- **Implementation**
  - **Some AATT Technologies have been integrated into FAA Operational Evolution Plan**
    - **FFP1**
      - **TMA, pFAST, SMA**
    - **FFP2**
      - **SMS, McTMA, D2**
  - **Other promising AATT elements**
    - **Post OEP plans less clear**
  - **Issues of transitioning technology**
    - **TRL 6 model is too simple**
      - **Need customer involvement and resources early and in transition**
    - **Lessons learned fielding research prototype systems in national infrastructure**
    - **Automation approaches vulnerable to Labor concerns**

AATT - Findings

- **Resources**
  - Episodic (5 year) programs make it difficult to have impact on ATM systems which have 20 year transition time constants
    - *"As program is getting mature, gaining credibility, interactions set up and starting to have impact it is ending"*
  - Need to consider and plan for transition resources
    - NASA and FAA sides
  - Need for balanced portfolio of near and long term elements
    - Support for fielding and transition appears to have siphoned resources away from longer term aspects of project

SATS Project Goals

- **Enterprise Goal:** "Increase Mobility - Enable more people and goods to travel faster and farther, anywhere, anytime with fewer delays."

- **Project Goal:** "Enable the use of over 5,000 small airports for on-demand, point to point air transportation"

- **Project Outputs:**

  2005 Demonstration of SATS technologies, capability and value

  - Flight demo of aircraft self-separation and sequencing in non-towered, non-radar airspace

  - Flight demo of cockpit systems that enable navigation to and from runways in near all-weather conditions, without the addition of traditional ground infrastructure.

  - Assessment of SATS economic viability and impact on national airspace and airport infrastructure

SATS - Findings

- **Goals**
  - **The goals of the SATS project were not clearly articulated in the material presented.**
  - **Suggest including SATS Ops Capability in goal**
    - **Higher volume ops in non-radar and non-towered airports**
    - **Lower landing minimums at Minimally Equipped Facilities (200, 1/2)**
    - **Increased Single Pilot Safety and Mission Reliability**
    - **Enroute Procedures & Systems for Integrated Ops**
  - **The rationale for the demonstration outputs was not clear.**
    - **What are the key questions or issues to be addressed**
    - **How was the point design of the demonstration system determined**
    - **How will this demonstration support future procedures, certification or development**
    - **What are the new technologies being developed or demonstrated**
  - **The TF strongly supported the goal of assessing economic viability**
  - **Some concern that the SATS goals may adversely affect other Airspace and mobility goals**

SATS - Findings

- **Technology/Approach**
  - The TF questioned the approach of focusing on point technology demonstrations
  - The basis for the technologies to be demonstrated was not clear.
    - Most technologies discussed appear to be existing or straightforward extrapolation of existing technologies.
    - What alternatives were considered?
    - What drove the design decisions (rationale)
    - Specific integrity concerns were raised regarding the Airport Management Module
  - It was not clear how the expected results would advance the understanding of key issues, technology base or provide a basis for future certification or standards
  - The assessment of economic viability requires capabilities that will "push the envelope" of the state of the art; over-simplified approaches may lead to misleading results

SATS - Findings

- **Coordination, Integration**
  - **There is good coordination between NASA, participating State governments and the participating industry and research partners through the SATS Alliance**
  - **There is some coordination between NASA and the FAA at the REDAC and project level. However the level of FAA commitment (people and financial) is limited by other priorities.**
  - **Concern that the SATS project appears to be answering to too many constituencies.**
    - **Too many sources of direction**

SATS - Findings

- **Implementation**
  - **There does not appear to be a clear plan for implementation**
  - **The next step after technology demonstration is not clear**
  - **It is not clear that the key regulatory and operational elements at the FAA have been sufficiently engaged to identify the key barriers to implementation of the SATS vision**

SATS - Findings

- **Resources**
  - The SATS resources appear to have been spread thinly across the NCAM consortium and the 4 SATSLab Partnerships (FL, MD, NC, VA)

VAMS Project Goals

- **Goal:** "**To develop capabilities that lead to a significant increase in the capacity of the National Airspace System, while maintaining safety and affordability**"

- **Objectives:**
    1. *Define Potential Operational Concepts*
    2. *Generate Supporting Technology Roadmaps*
    3. *Establish Capability to Assess Concepts*

VAMS - Findings

- **Goals**
  - **The goals of the VAMS project appear to be relevant.**
  - **The Task Force would like to see "improved understanding the current NAS" as an objective**
  - **The Assessment Objective (3) may be unrealistic depending on the level of assessment expected.**
    - **It is difficult to fully assess the current system**
    - **Suggest re-scoping objective to assess key issues in operational concepts**

VAMS - Findings

- **Technology/Approach (Ops Concepts)**
  - **Independent generation of scenarios is good approach**
    - **Need to include operational expertise**
  - **Need demand basis and future constraints**
  - **Not clear that synthesizing from multiple independent concepts will be successful**
  - **Concerns regarding Ops Concept Downselect**
  - **Roadmaps will be critical, need to develop methodology**
    - **Include key decision points in methodology**
    - **Robustness criteria**

VAMS - Findings

- **Technology/Approach (Modeling)**
  - **TF Supported the Technical Modeling Approach and had detailed suggestions:**
    - "Interactive agents is the right approach"
    - "Make sure that sim capabilities are not only physics based but include symbolic reasoning and agent behavior"
    - "Consider parametric approaches to deal with uncertainty"
    - "Need to impose documentation requirements to assure that rationale is captured"
    - "Need hierarchy of models not one super model"
  - **TF was concerned that the expectations for the modeling may be unrealistic**
    - What is a "validated" model
    - Concern on how models will project for future concepts
    - Need to manage expectations
  - **Assessment and Modeling capability should be driven by key questions**
    - Current modeling efforts have to guess at questions
  - **TF supports the delay of Human in the Loop simulation requirements pending key questions**
  - **Need for a more detailed model review**
    - Based on sample problems

VAMS - Findings

- **Coordination, Integration**
  - **FAA coordination needs to be strengthened**
  - **NASA and FAA need to work together to assess concepts, methods and tools that will support the FAA's and the nation's air traffic modernization needs**

VAMS - Findings

- **Implementation**
  - **Internal - OK**
  - **External - Unclear**

VAMS - Findings

- **Resources**
  - **Not addressed**

AOS Project Goals

- **Goal:** "To improve the design of human-centered automation and interfaces, decision-support tools, training protocols, team practices and organizational procedures supporting current and future ATM systems"

- **Focus**
  - Minimize human error and optimize interaction between automated ATM systems & human operators - pilots, controllers, dispatchers, etc.

- **Objectives:**
  1. *Identifying, verifying and developing advanced technology concepts, methods, and procedures*
  2. *Transferring them to industry or government for application*
  3. *Providing foundation for systems technology programs*
  4. *Contributing facilities and human factors expertise to industry and government cooperative efforts*

AOS - Findings

- **Goals**
  - **The goals of the AOS project appear to be relevant.**
  - **The Task Force suggests developing approaches to included human considerations early in system design as an objective**
  - **The Task Force suggested that the goals be broadened to include non ATM human-centered systems such as space or maintenance applications**

AOS - Findings

- **Technology/Approach**
  - **Current Focus Areas**
    - **Psychological & Physiological Stressors & Factors**
    - **Human/Automation Integration Research**
      - **System Design and Analysis**
      - **Human Automation Reliability**
    - **Human Error & Countermeasures**
      - **Skilled Performance**
      - **Fatigue Countermeasures**
  - **Current approach is dependant on resident expertise**
    - **Focused but limited areas of nationally recognized expertise**
  - **What are the key issues for the future**
    - **Eg distributed human systems and team resource management**
  - **Recommend Strategic Planning Effort and Intellectual Renewal Plan**
  - **Recommend stronger links to development projects**

AOS - Findings

- **Coordination, Integration**
  - **Excellent**
    - **Based on HF Reputation and Credibility**
  - **Examples**
    - **NTSB**
    - **FAA**
    - **Numerous Airlines**
    - **GA Community**
    - **Boeing**
    - **Navy**
    - **Flight Safety Foundation**
    - **VA**
  - **Strong University Connection**

AOS - Findings

- **Implementation**
  - **Training materials**
  - **Advisory Circulars**
  - **Regulatory support**
  - **Investigations**
  - **Strong in cockpit**
  - **Weaker in ATC, AOC, TFM**

AOS - Findings

- **Resources**
  - **Issue of maintaining competency in anticipation of need.**
    - **Level-funding base research to end in 07**
  - **Issue of maintaining NASA's leadership role in Aviation Human Factors**
    - **Has historically been a national core competency**
    - **Ability to respond to need as national resource**
  - **The nation and NASA must determine areas of important national need and maintain a balanced portfolio in these areas.**
  - **Human resource issues**